RESEARCH IN LABORATORY OF BIOCYBERNETICS, FACULTY OF ELECTRICAL ENGINEERING, UNIVERSITY OF LJUBLJANA

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В роботі описано дослідження в лабораторії біокібернетики електроінженерного факультету люблянського університету.

Since its foundation in 1963, the Laboratory of Biocybernetics has been involved in the study of interaction between electromagnetic fields (EMFs) and biological systems. This includes both the *i*nvestigation of harmful effects of EMFs on organisms and the exploitation of beneficial effects of EMFs for therapeutic and diagnostic purposes. During the period from the mid-1960s to the end of the 1970s, the major research topic was Functional Electrical Stimulation (FES) for the restoration of motor functions impaired by different types of injuries or neuromuscular diseases.

Since 1980s, our main field of research are the investigations of the influence of electric currents and electromagnetic fields on the physiological state of cells, tissues, organs, and the body as a whole. Our investigations gradually focused on cell membrane electroporation with its applications in biology, biotechnology, and medicine, particularly electrochemotherapy of tumors (ECT) and electrogene therapy (EGT), where we are among the leading research groups in the world. Our publications in the field have received over 10 thousand pure citations, we were the chairs of the COST action TD1104 – European network for development of electroporation-based technologies and treatments (EP4Bio2Med), that ran from 2011 until 2016, bringing together 581 researchers of electropotion from 243 research institutions and 28 hi-tech companies from 43 different countries. Since 2003 we are organizers (first bi-annually, and since 2011 annually) the workshop and postgraduate course Electroporation-Based Technologies and Treatments, attracting each year over 50 attendees, and in total over 700 participants from 39 different countries. Professor Damijan Miklavčič, the head of the laboratory, is the editor of the Handbook of Electroporation, published in 2017 by Springer, currently spanning almost 3000 pages, and available in print as well as online.

We are studying the electroporation phenomenon using both theoretical and experimental approaches, and on scales ranging from atomic-molecular (MD simulations), membrane-level (lipid bilayers and vesicles), organelle- and cell-level (cells in suspension, attached cells, and clusters of them), up to tissues and organs (experiments on animals in cooperation with the Institute of Oncology Ljubljana), and we also collaborate in clinical studies (again in cooperation with the Institute of Oncology Ljubljana). Our work encompasses analytical derivations, numerical computations and simulations, experiments *in vitro* and *in vivo*, treatment planning, and we are also developing devices for research an clinical use, as well as information technology for clinical trials. A more detailed description of our work in each field can be obtained by following the links in the research tab.